innovative air handling units

EN

# Compact control gear for Supply and Supply-Exhaust Air Handling Units

## VS 10-75 CG OPTIMA

## VS 40-150 CG OPTIMA SUP

## VS 40-150 CG OPTIMA SUP-EXH

Operation and Maintenance Manual

ventus

DTR-CG OPTIMA – ver.2.0 (05.2012)

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**Control boxes VS 10-75 CG OPTIMA; VS 40-150 CG OPTIMA SUP; VS 40-150 CG OPTIMA SUP-EXH are designed according to the following European standards: EN 60335-1; EN 60439-1; EN 60439-3; EN 50082-1; EN 50081-1**

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# USER'S MANUAL

## 1. DESCRIPTION OF CONTROLS

### INTRODUCTION

**Application:**

Protection and control of supply and supply-exhaust air handling units equipped with:

- two fan sets with frequency converters
- two air dampers
- cooler or heater
- heat recovery system

Special control applications marked with N… code, which are exclusive for N-Type duct units, are capable of protection and control of units equipped with:

- water heater and a cooler
- water heater and glycol preheater
- extra functionality is backwater regulation for protection of the heater coil

**Range of operation:**

| **VS 10-75 CG OPTIMA** | **VS 40-150 CG OPTIMA SUP**<br>**VS 40-150 CG OPTIMA SUP-EXH** |
|---|---|
| Air handling units equipped with direct driven plug fans powered by frequency converters | |
| up to 2,2kW | up to 11kW |

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### MAINS SWITCH

**Function:**
Switching the control box On / Off

### SIGNALLING CONTROLLER STATUS

By the top edge of the PCB there are two LED indicators:

1. Red – ALR – to indicate the alarm conditions of the controller or the application
   a. Off – if no alarms are recognized
   b. Blinking – in case of alarm conditions

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2. Green – COMM – to indicate the state of Modbus Master communication line
   a. Off – no communication, HMI OPTIMA not connected
   b. Blinking – in case of stable communication

| | |
|---|---|
| ! | 1. All control boxes of the VS…CG OPTIMA… typeline need to be powered from the main switchgear equipped with appropriate protection of wires powering the control box.<br>2. Assembly, wiring and start-up of the control gear should by done by qualified staff only.<br>3. Control boxes VS…CG OPTIMA… are intended only for indoor operation. |

## CONTROL PANEL HMI OPTIMA

**LCD Display**
Displaying available parameters, settings and current values
Top line – name of the parameter
Bottom line – value or selected option
***Note!*** *If the text length exceeds the line limit, the text begins to scroll.*

**Keypad**

- Left / Rigth arrows
  to navigate across the menus and to change the parameter value
- OK
  to enter another level of the menu, to enter parameters, to approve and save changed settings, to acknowledge alarms
- C
  to leave current menu level, to cancel settings and selections

***Note!*** *The mark → shows a link to the next screen. Push OK to enter.*

*Keep the [OK] button pressed for approx. 3 seconds to enter internal HMI menu*

*Keep the [C] button pressed for approx. 3 seconds to enter Alarm menu*

*Refer to Advanced Manual for details.*

**Inbuilt temperature sensor**
Measurement of room temperature.
***Note!*** *Mind the proper installation and placing of the HMI OPTIMA if it is intended to measure room temperature in the reliable way.*

**LED Indicator *Alarm / comm.***
Indication of the unit and HMI state

- Off – no power supply, lost communication with the controller, HMI malfunction possible
- Blinking green – correct and stable communication with the controller
- Flashing red – new alarm needs to be acknowledged
- Permanent red – acknowledged alarm requires further actions to remove the cause of the problem

**Functions:**

- Air handling unit operation, parameterization and maintenance
- Selection of control application
- Access to operation parameters of the AHU subassemblies
- Time zones setting
- Displaying and canceling alarm statuses, viewing alarm history

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| | |
|---|---|
| ! | *Parameters available in the LCD window depends on a AHU type and the control application. Hence in AHUs not equipped with heater, options related to the heating module will not be visible.* |

## SYSTEM START-UP

| | |
|---|---|
| ! | *Operation of the AHU is strictly arrested by the fire-protection alarm, activation of the thermal protection of fans' motors, threefold activation of the protection of electric heater and threefold activation of the anti-frost thermostat. Each of these events requires removing the cause of the alarm and then canceling it (see more details in Advanced Manual).* |

## SWITCHING ON POWER SUPPLY

Switching on power supply of the control gear with the mains switch (Q1M). Correct controller operation is indicated by green LED “COMM” blinking on the PCB inside the control box and on the HMI OPTIMA device.

The system is ready for operation immediately after switching on.

## QUICK START

For quick access there are four screens with the most basic information and settings. These are sufficient for daily operation. To run the unit quickly just do:

- Check the **Unit state** screen

  **Stop** means, the unit is already configured, is free of alarms and other malfunctions and is ready to run
- Check the **Temp. setting** and put the correct value if necessary
- Check the **Temp.readout**
- Select the **Operation mode** according to current expectations

  1. Stop – unit remains stopped
  2. Stage I – unit run, fans set to 1st speed (low capacity)
  3. Stage II – unit run, fans set to 2nd speed (high capac.)
  4. Standby – unit stopped to save energy, but ready for automatic start up, to keep the temperature within specified safe range
  5. Calendar – unit working automatically, according to the real time clock settings

1

| Unit state |
|---|
| Stop |

2

| Operation mode |
|---|
| Stop |

3

| Temp. setting |
|---|
| 22.0 °C |

4

| Temp. readout |
|---|
| 25.3 °C |

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## 2. APPLICATION BASICS

### MAIN MENU STRUCTURE

**Unit state** – indicates the current state of the air handling unit and the control system

- Stop – normal stop of the unit
- Running – normal operation of the unit with ventilation and heating / cooling / recovery enabled according to current unit state and demand
- Alarm state – unit in alarm state
- Fault stop – unit stopped by a fault
- Init. heating – initial heating of the water heater, to prevent from frost alarm during start-up
- Service mode – unit ready to change basic settings like application code

***Note!*** *That is initial factory setting of the controller. See Advanced Manual for details.*

- Fast heating – special mode for recirculation, to ensure quick heating up with max. possible recirculation
- Overrun – special mode for stopping the unit if equipped with electrical heater or DX-cooler, delays stopping the fan, until safe conditions for the heat exchanger are established

**Operation mode** – used to set the main operating mode from the HMI OPTIMA

- Stop – unit stopped
- Stage I – unit running, fans set to 1st speed
- Stage II – unit running, fans set to 2nd speed
- Standby – unit stopped to save energy, but ready for automatic start up, to keep the main temperature within specified safe range
- Calendar – unit working automatically, according to the real time clock settings

**Temp. setting** – setpoint for temperature regulator

- Low limit: 5°C
- High limit: 35°C
- Default: 22°C

**Temp. readout** – current value of the temperature measured by the main sensor

**PARAMETERS** – jump to read out main working conditions

**CALENDAR** – jump to settings for time scheduled operation

**SETTINGS** – jump to detailed controller configuration

**SERVICE MENU** – jump to fundamental settings of the control system, like application code, used in Service mode of the controller

| |
|---|
| Unit state<br>Service mode |
| Operation mode<br>Stop |
| Temp. setting<br>22.0 °C |
| Temp. readout<br>25.3 °C |
| PARAMETERS → |
| CALENDAR → |
| SETTINGS → |
| SERVICE MENU → |
| EN / PL / RU → |
| Change password |
| v.2.1 20-04-12<br>VS-OPTIMA |

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**EN / PL / RU** – jump to language selection

**Change password** – allows entering specific password to protect the controller from unintended access

**v.2.1 20-04-12** – application identifier

**VS-OPTIMA** – controller type identifier

***Note!*** *All the menus are dynamically changed, as they depend on the application settings and the password level*

*If the system did not start, check the F1 protection status*

*Correct device operation depends on the application settings. Choosing and setting up the application should be done by qualified service provider, according to recommendations of Advanced Manual*

## HMI OPTIMA SETTINGS & CONNECTING TO THE CONTROLLER

Holding the [OK] button, the internal menu of the HMI can be entered.

**Choose device** – can be used for operation of single HMI OPTIMA with multiple controllers.

- Only one device – used for 1:1 connection with single controller at fixed address “1” (recommended mode)
- Scan devices – searching through the bus to detect all addresses occupied by several controllers

**Communication period** – gap between updating information with the controller.

- Low limit: 0.0s
- High limit: 10.0s
- Default: 0.5s (recommended)

**Communication timeout**– limit for the response from the controller. Check if using converters / repeaters on the communication line.

- Low limit: 0.0s
- High limit: 5.0s
- Default: 0.5s (recommended)

**Contrast / Minimal brightness / Maximal brightness** – settings for the LCD appearance

**Activity time** – time to switch to idle state if no button operation is performed

**After activity time** – defines the HMI behavior after switching to idle state

- Nothing – don’t change the screen
- Alarms menu – jump to alarms menu if any alarm is reported
- Alarms/1st page – jump to alarms menu in case of the alarm otherwise jump to main menu

Choose device

Communication period
0.5s

Communication timeout
0.5s

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| | |
|---|---|
| **HMI com speed / RS485M com speed** – settings for communication speed between the HMI and the controller. First parameter refers to HMI speed, the other refers to the controller.<br>***Note!*** *The speed settings must match each other. Otherwise the connection will be lost.*<br>*Observe communication speed in case of faulty connection.*<br>*See the electrical diagrams for the details.* | |
| **LANGUAGE SELECTION English / Polski / Русский** | |
| HMI OPTIMA supports the following languages:<br>EN English<br>PL Polish<br>RU Russian<br>English is set as a default language.<br>***Note!*** *The alarm descriptions are always given in English.* | |
| **ENTERING THE PASSWORD** | |
| Some menus are protected with a password, to avoid unintentional change, that could be dangerous for the unit or for the user. To access that parts of the menu, you will be asked to enter the password.<br>Enter password<br>0 _ _ _<br>Default password: 1111<br>To enter the numbers use arrow keys and confirm each time with [OK] button. | |
| **3. CALENDAR →** | |
| Calendar is an automatic functionality to provide scheduled operation of the air handling unit according to the Real Time Clock. | CALENDAR |
| **Set date** – shows current date and allows for entering new value<br>**Set time** – shows current time and allows for entering new value<br>***Note!*** *At first power up the RTC could be blocked. It's easy to find by not running seconds on the display. However, after any change of the time set, RTC retains normal operation.* | Set date<br>Th 24-02-11<br>Set time<br>10:05.42 |
| **Annual** – 1st (the highest) priority schedule for setting special dates like holidays.<br>**Monthly** – 2nd priority schedule for setting special dates according to monthly routines, like factory maintenance each 1st day of the month.<br>**Weekly** – 3rd priority schedule for weekly routines, like weekends<br>**Daily** – 4th priority schedule for daily routines, like working hours<br>**Clear all** – erase all settings for calendar | Annual<br>Monthly<br>Weekly<br>Daily<br>Clear all |

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| **CALENDAR → ANNUAL →** | |
|---|---|
| Inside the “Annual” menu there are visible all previously stored programs and also the link to “New program” editor.<br>Entering new program allows for setting:<br>▪ Date and Time “from”<br>▪ Date and Time “to”<br>▪ Operation mode<br>▪ Temperature setpoint<br>New program editor ends with SAVE option. Each program must be saved before leaving the editor.<br>Entering existing program allows for changing the settings (which must be confirmed with SAVE option). There’s also DELETE function, to erase selected program. | New program →<br>01-01 00:00.00<br>02-01 07:00.00<br>24-12 17:00.00<br>27-12 07:00.00 |
| **CALENDAR → MONTHLY →** | |
| Entering new program allows for setting:<br>▪ Day and Time “from”<br>▪ Day and Time “to”<br>▪ Operation mode<br>▪ Temperature setpoint | New program →<br>01 18:00.00<br>01 23:00.00 |
| **CALENDAR → WEEKLY →** | |
| Entering new program allows for setting:<br>▪ Week day and Time “from”<br>▪ Week day and Time “to”<br>▪ Operation mode<br>▪ Temperature setpoint | New program →<br>Fr 18:00.00<br>Mo 07:00.00 |
| **CALENDAR → DAILY →** | |
| Entering new program allows for setting:<br>▪ Time “from”<br>▪ Time “to”<br>▪ Operation mode<br>▪ Temperature setpoint | New program →<br>07:00.00<br>15:00.00<br>15:00.00<br>17:00.00<br>17:00.00<br>07:00.00 |

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| CALENDAR EXAMPLE | |
|---|---|
| Intended scheme of operation for the office:<br>1. Daily:<br>a. Normal working hours: 7 – 15 – work in “comfort” conditions<br>b. Overtime: 15 – 17 – work in “comfort” conditions, but save energy<br>c. Office empty overnight – keep only safe conditions, save much energy<br>2. Weekly:<br>a. Working days: Monday to Friday<br>b.Weekend: keep only safe conditions, save much energy<br>3. Yearly:<br>a. Christmas: 24th – 26th December – keep only safe conditions, save much energy | |
| Programming step 1 – do the settings for holidays<br>CALENDAR → ANNUAL → NEW PROGRAM<br>Date from: 24-12<br>Time from: 17:00.00<br>Date to: 27-12<br>Time to: 07:00.00<br>Operation mode: Standby<br>Temp. setting: 18°C<br>***Note!*** *Always remember to save your settings!* | New program →<br>Date from 24-12<br>Time from 17:00.00<br>Date to 27-12<br>Time to 07:00.00<br>Operation mode Standby<br>Temp. Setting 18°C<br>Save |
| Programming step 2 – do the settings for weekend exception<br>CALENDAR → WEEKLY → NEW PROGRAM<br>Week day from: Friday<br>Time from: 17:00.00<br>Week day to: Monday<br>Time to: 07:00.00<br>Operation mode: Standby<br>Temp. setting: 18°C<br>***Note!*** *Always remember to save your settings!* | New program →<br>Week day from Fr<br>Time from 17:00.00<br>Week day to Mo |

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| | |
|---|---|
| | Time to<br>07:00.00<br>Operation mode<br>Standby<br>Temp. Setting<br>18°C<br>Save |
| Programming steps 3/4/5 – do the settings for daily operation<br>CALENDAR → DAILY → NEW PROGRAM<br>Time from: 07:00.00<br>Time to: 15:00.00<br>Operation mode: Stage II<br>Temp. setting: 22°C<br>CALENDAR → DAILY → NEW PROGRAM<br>Time from: 15:00.00<br>Time to: 17:00.00<br>Operation mode: StageII<br>Temp. setting: 21°C<br>CALENDAR → DAILY → NEW PROGRAM<br>Time from: 17:00.00<br>Time to: 07:00.00<br>Operation mode: Standby<br>Temp. setting: 18°C<br>***Note!*** *Always remember to save your settings!* | New program →<br>Time from<br>07:00.00<br>Time to<br>15:00.00<br>Operation mode<br>Standby<br>Temp. Setting<br>18°C<br>Save |
| **4. PARAMETERS →** | |
| Menu “Parameters” gives information on actual status of the unit.<br>***Note!*** *Data in “Parameters” is read only. For setpoints, limits, PI tuning refer to “Settings”.* | PARAMETERS → |
| **PARAMETERS → TEMPERATURES →** | |
| Readout of the temperatures<br>▪ Main sensor – temperature from room or supply sensor, main value for temperature regulators<br>▪ Room sensor – temperature in the room, measured by HMI OPTIMA<br>▪ Supply sensor – temperature in supply duct<br>▪ External sensor – outside temperature<br>▪ After recovery sensor – exhaust air temperature sensor after the recovery system, protects from freezing the recuperator<br>***Note!*** *All values given in Celsius degrees.* | TEMPERATURES →<br>Main sensor<br>22.6°C |

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| PARAMETERS → DAMPERS → | |
|---|---|
| State of the intake / outlet dampers<br>▪ Closed<br>▪ Opened | Dampers<br>Closed |
| **PARAMETERS → FANS →** | |
| State of the fans<br>**Fans status** – indicates which fans are currently running<br>▪ Stop – none<br>▪ Supply – only supply fan is running<br>▪ Exhaust – only exhaust fan is running<br>▪ Supply/Exhaust – both fans are running<br>**Supply fan rate** – readout of control signal for the supply fan, range 0..100%<br>**Exhaust fan rate** – readout of control signal for the supply fan, range 0..100%<br>***Note!*** *Control signal for fans is transmitted via Modbus link to the frequency converter.* | Fan status<br>Stop<br>Supply fan rate<br>0%<br>Exhaust fan rate<br>0% |
| **PARAMETERS → WATER HEATER →** | |
| State of the water heater<br>**Pump status** – state of the circulation pump<br>▪ Off<br>▪ On<br>**Valve opening** – control signal for the 3-way valve, range 0..100% (corresponding to 0..10V hardware output) | Water heater →<br>Pump status<br>Off<br>Valve opening<br>0% |
| **PARAMETERS → ELECTRIC HEATER →** | |
| Readout of the control signal for the electric heater, range 0..100% (corresponding to 0..10V hardware output) | Electric heater<br>0% |
| **PARAMETERS → WATER COOLER →** | |
| State of the water cooler<br>**Pump status** – state of the circulation pump<br>▪ Off<br>▪ On<br>**Valve opening** – control signal for the 3-way valve, range 0..100% (corresponding to 0..10V hardware output) | Water cooler →<br>Pump status<br>Off<br>Valve opening<br>0% |

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| PARAMETERS → DX COOLER STATUS → | |
|---|---|
| State of the DX cooler<br>▪ Off<br>▪ On<br>***Note!*** *Cooler status could be affected not only by operation mode of the unit. Safe operation of the DX cooler requires some minimal working / resting times to be included in the control strategy.* | DX cooler status<br>Off |
| **PARAMETERS → COOLER →** | |
| **Cooler status** - state of the cooling devices<br>▪ Off<br>▪ On<br>**Cooling rate** - percentage of cooling control signal, range 0..100% (corresponding to 0..10V hardware output)<br>Note! This representation of cooler state is exlusive for N-Type units and N… control applications, which do not distinguish between water- and DX-coolers. | COOLER →<br>Cooler status<br>Off<br>Cooling rate<br>0% |
| **PARAMETERS → PREHEATER →** | |
| State of the glycol pre-heater<br>**Pump status** – state of the circulation pump<br>▪ Off<br>▪ On<br>**Valve opening** – control signal for the 3-way valve, range 0..100% (corresponding to 0..10V hardware output) | PREHEATER →<br>Pump status<br>Off<br>Valve opening<br>0% |
| **PARAMETERS → UNIVERSAL COIL →** | |
| State of the universal cooling / heating coil<br>**Pump status** – state of the circulation pump<br>▪ Off<br>▪ On<br>**Valve opening** – control signal for the 3-way valve, range 0..100% (corresponding to 0..10V hardware output)<br>**Mode** – current state of the coil<br>▪ Winter (heating) – coil is working as a heater, the control signal increases if the temperature is below the setpoint<br>▪ Summer (cooling) – coil is working as a cooler, the control signal decreases if the temperature is below the setpoint<br>***Note!*** *The pipeline has to be switched manually between supplying from chiller or from boiler. The mode selection must be done according to the actual state of the piping.* | Universal coil →<br>Pump status<br>Off<br>Valve opening<br>0%<br>Mode<br>Winter (heating) |

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| | |
|---|---|
| **PARAMETERS → RECOVERY RATE →** | |
| Readout of control signal for the rotary heat regenerator or plate cross-flow recuperator, range 0..100% | Recovery rate<br>0% |
| **PARAMETERS → ROTARY REGEN. →** | |
| State of the rotary heat regenerator<br>**Recovery rate** - readout of control signal for the recovery unit, range 0..100%<br>**Frequency** – readout of actual output from the frequency converter<br>**Fault code** – status word read from the frequency converter<br>***Note!*** *For detailed information on fault codes, refer to the manual of the frequency converter.* | Rotary regen. →<br>Recovery rate<br>0%<br>Frequency<br>0.0Hz<br>Motor RPM<br>0 rpm<br>Fault code<br>0x00 |
| **PARAMETERS → MIXING RATE →** | |
| Readout of the control signal for the mixing dampers, range 0..100% (corresponding to 0..10V hardware output) | Mixing rate<br>100% |
| **5. SETTINGS →** | |
| Settings is the part of the menu, where setpoints, limits, PI parameters and other configurable values are accessed. | |
| **SETTINGS → DEF. WORK MODE →** | |
| Defines the default working mode for the calendar if none of the settings matches current date and time. This could happen if the “Calendar” operation will be selected as the operation mode while the whole calendar was left blank.<br>▪ Stop (factory setting)<br>▪ Stage I<br>▪ Stage II<br>▪ Standby<br>***Note!*** *In such case, the temperature setpoint is taken from the general setpoint from the main menu.* | Def. work mode<br>Standby |
| **SETTINGS → STANDBY MODE →** | |
| Defines the conditions for the “standby” functionality to be activated.<br>**Active for** – enables the standby function for different types of heat exchangers<br>▪ None – standby function disabled | Standby mode →<br>Active for<br>Heating/Cooling |

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| | |
|---|---|
| ▪ Heating – standby enabled only for heating (unit starts when the room gets too cold)<br>▪ Cooling – standby enabled only for cooling (unit starts when the room gets too warm)<br>▪ Heating/Cooling – standby enabled for both situations<br>***Note!*** *Standby mode settings must be related to the heat exchangers actually available in the unit.*<br>**Standby hyster.** - defines how much the actual temperature should differ from the temperature setpoint to activate the standby heating up or cooling down<br>***Note!*** *The acceptable range of room temperatures in standby mode equals the temperature setpoint +/- hysteresis.* | Standby hyster.<br>4°C |
| **SETTINGS → SEASON →** | |
| Exclusive setting for the units with universal coil. Defines in which season the unit works and therefore determines the behavior of the temperature regulators.<br>▪ Winter - the universal coil acts as a heater (factory setting)<br>▪ Summer – the universal coil acts as a cooler | Season<br>Winter |
| **SETTINGS → PERFORMANCE →** | |
| Settings related to the capacity of fans and heat exchangers.<br>**Stage I HE-limit** – defines the max. control signal for the heater when the fans are working on Stage I<br>▪ Low limit: 10%<br>▪ High limit: 100%<br>▪ Default: 100%<br>**Stage I Clg-limit** – defines the max. control signal for the cooler when the fans are working on Stage I<br>▪ Low limit: 10%<br>▪ High limit: 100%<br>▪ Default: 100%<br>**Sup Fan Stage I / Exh Fan Stage I** – setting for the fan capacity on Stage I operation mode<br>▪ Low limit: 20%<br>▪ High limit: 100%<br>▪ Default: 50%<br>**Sup Fan Stage II / Exh Fan Stage II** – setting for the fan capacity on Stage II operation mode<br>▪ Low limit: 20%<br>▪ High limit: 100%<br>▪ Default: 100% | Performance<br>Stage I HE-limit<br>100%<br>Stage I Clg-limit<br>100%<br>Sup Fan Stage I<br>50%<br>Sup Fan Stage II<br>100% |

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**SETTINGS → TEMP. REGULATOR →**

**Supply $T_{max}$** – setting for the upper limit of supply air temperature
- Low limit: 20°C
- High limit: 50°C
- Default: 40°C

**Supply $T_{min}$** – setting for the lower limit of supply air temperature
- Low limit: 0°C
- High limit: 30°C
- Default: 15°C

**Min.cooling temp.** - lower limit for activating the cooling. When the external teperature falls below the limit, the cooling functionality is disabled and the unit can only ventilate to cool down the room.
- Low limit: -10°C
- High limit: 20°C
- Default: 12°C

**Heating PI / Cooling PI / Supply PI** – settings for PI regulators in temperature control loop
- $K_p$ – gain for the regulator
- $T_i$ – integral factor for the regulator
- Default for heating and cooling: $K_p$=1; $T_i$=60s
- Default for supply limits: $K_p$=2; $T_i$=10s

***Note!*** *The heating and cooling PI regulators refer to both heating and cooling coils and to heat recovery devices.*

*The supply PI regulator is responsible for keeping the supply air within the limits defined by Supply $T_{max}$ and Supply $T_{min}$.*

Temp. Regulator

Supply $T_{max}$
30°C

Supply $T_{min}$
15°C

Min.cooling temp.
15°C

Heating PI →

$K_p$ for heating

$T_i$ for heating

**SETTINGS → DAMPERS →**

Settings refer to the special intake damper (anti freeze damper) in the units VS10-15 with plate cross-flow recuperator without bypass.

**Min fresh air** – setting for the minimum fresh air ratio at full frost protection
- Low limit: 0%
- High limit: 100%
- Default: 30%

**Frost protection** – setting for the lower limit of the exhaust air temperature after the PCR unit
- Low limit: -10°C
- High limit: 15°C
- Default: 5°C

Dampers →

Min fresh air
30,00%

Frost protection
3°C

$K_p$
10

$T_i$
180

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| | |
|---|---|
| **$K_p$ / $T_i$** – settings for frost protection PI regulator<br>▪ $K_p$ – gain for the regulator<br>▪ $T_i$ – integral factor for the regulator<br>▪ Default: $K_p$=5 / $T_i$=10s | |
| **SETTINGS → FANS →** | |
| **Pressure dela**y – time to check the fan presostats after the fan startup<br>▪ Low limit: 0s<br>▪ High limit: 3600s<br>▪ Default: 30s<br>**Switch-on delay** – startup delay for the unit.<br>▪ Low limit: 0s<br>▪ High limit: 3600s<br>▪Default: 5s<br>**Switch-off delay** – delay for stopping the fans in case of units equipped with electric heater or DX cooler. Applied if the heater or cooler was actually working.<br>▪ Low limit: 0s<br>▪ High limit: 3600s<br>▪ Default: 30s<br>**Sup fan delay** – time between applying opening signal for the dampers and starting the supply fans.<br>▪ Low limit: 0s<br>▪ High limit: 3600s<br>▪ Default: 10s<br>**Exh fan dela**y – time between applying start signal for the supply fans and exhaust fans<br>▪ Low limit: 0s<br>▪ High limit: 3600s<br>▪ Default: 10s | Fans →<br>Pressure delay<br>30s<br>Switch-on delay<br>5s<br>Switch-off delay<br>30s<br>Sup fan delay<br>10s<br>Exh fan delay<br>10s |
| **SETTINGS → HEATER →** | |
| **Initial heating / Max T.Out** – upper temperature limit for the initial heating procedure. At this point the valve begins to open<br>▪ Low limit: 0°C<br>▪ High limit: 30°C<br>▪ Default: 8°C<br>**Initial heating / Min T.Out** – lower temperature limit for the initial heating procedure. At this point the valve reaches 100% opening<br>▪ Low limit: -40°C<br>▪ High limit: 0°C<br>▪ Default: -15°C | Heater →<br>Initial heating →<br>Max T.Out<br>8°C<br>Min T.Out<br>-15°C |

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***Note!*** *Between the points of Max and Min T.Out the valve position is calculated with linear characteristics. For example at half the range, the valve will be 50% opened.*

**Initial heating / Preheating time** – setting for the initial heating timer. After that time unit starts normal operation and the valve opening relies on the PI regulators for heating sequence.

- Low limit: 0s
- High limit: 3600s
- Default: 30s

**Initial heating / Fall ramp** – time for the valve to close after completing the initial heating procedure. By the time of controlled closing, the valve position should meet the actual signal from the PI output, so the crossing throug 0% valve opening will be avoided. The fall ramp is intended to minimize the risk of freezing alarms, which could happen in case of closing the valve suddenly.

- Low limit: 0s
- High limit: 3600s
- Default: 30s

**Pump work temp.** – setting for the external temperature which forces the circulation pump to work continuously.

- Low limit: -20°C
- High limit: 15°C
- Default: 8°C

**Min. valve open** – lower limit for the valve position. In working unit, the valve control signal will be at least at that level

- Low limit: 0%
- High limit: 100%
- Default: 0%

**Pump protection / Set protection** – setting to enable/disable the protection against sticky sealing issue. The sticky sealing could happen in case of long term inactivity of the pump, when contaminations and deposits from the water could damage the mechanical sealing

- Not active (default setting)
- Active

**Pump protection / Stoppage period** – setting of the resting time for the pump

- Low limit: 1day
- High limit: 30days
- Default: 7days

**Pump protection / Run time** – setting of the operation time for the pump

- Low limit: 1s
- High limit: 3600s
- Default: 30s

Preheating time
30s

Fall ramp
30s

Heater →

Pump work temp.
8°C

Min. valve open
0,00%

Heater →

Pump protection →

Set protection
Not active

Stoppage period
7 days

Run time
30s

Tbwtr setpoint

Kp Tbwtr
1.0

Ti Tbwtr
60s

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**Tbwtr setpoint** - setting for the desired temperature of the backwater from the heater. If unit stopped, regulator keeps exactly the setpoint. If unit running, Tbwtr setpoint is considered as lower limit of backwater temperature. If the Tbwtr drops, the regulator forces the valve to open regardless to the main control loop for heating.

- Low limit: 20°C
- High limit: 70°C
- Default: 50°C

***Note!*** *The room could be overheated by backwater control feature. Tbwtr control has got higher priority than the main temperature control loop.*

***Note****! The backwater control feature is blocked if the outside temperature is higher than Pump work temp.*

- Kp Tbwtr - gain for the regulator
- Ti Tbwtr - integral factor for the regulator
- Default: Kp=1 / Ti=60s

**SETTINGS → PREHEATER →**

**Temp. setting** - setpoint for initial heater.
**Note!** Preheating regulator compares the setpoint with the B3 sensor readout. Regulation goal is to keep the B3 temperature equal to the setpoint.
**Note!** Observe the application diagrams for proper placement of the sensors.

- Low limit: -24°C
- High limit: 0°C
- Default: -9°C
- Kp - gain for the regulator
- Ti - integral factor for the regulator
- Default: Kp=1 / Ti=60s

**Min. valve open** – lower limit for the valve position. In working unit, the valve control signal will be at least at that level

- Low limit: 0%
- High limit: 100%
- Default: 20%

**Pump protection / Set protection** – setting to enable/disable the protection against sticky sealing issue. The sticky sealing could happen in case of long term inactivity of the pump, when contaminations and deposits from the water could damage the mechanical sealing

- Not active
- Active (default setting)

| |
|---|
| PREHEATER → |
| Temp.setting<br>-9°C |
| Kp<br>1.0 |
| Ti<br>60s |
| Min. valve open<br>20% |
| PUMP PROTECT. → |
| Set protection<br>Active |
| Stoppage period<br>7d |
| Run time<br>30s |

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| | |
|---|---|
| **Pump protection / Stoppage period** – setting of the resting time for the pump<br>▪ Low limit: 1day<br>▪ High limit: 30days<br>▪ Default: 7days<br>**Pump protection / Run time** – setting of the operation time for the pump<br>▪ Low limit: 1s<br>▪ High limit: 3600s<br>▪ Default: 30s | |
| **SETTINGS → CLG PUMP PROT. →** | |
| Cooling pump protection- optional functionality for the cooling medium pump to protect the pump from sticky sealing issue. See previous chapter for details **SETTINGS → HEATER →** | |
| **SETTINGS → DX COOLER →** | |
| **Min.work time** – setting for min. time of operation for units with DX cooler<br>▪ Low limit: 0s<br>▪ High limit: 3600s<br>▪ Default: 60s<br>**Min.break time** – setting for min. resting time for units with DX cooler<br>▪ Low limit: 0s<br>▪ High limit: 3600s<br>▪ Default: 60s<br>**Min.work temp.** – setting for the external temperature which disables the operation of the cooling.<br>▪ Low limit: 0°C<br>▪ High limit: 20°C<br>▪ Default: 12°C | DX Cooler →<br>Min.work time<br>60s<br>Min.break time<br>60s<br>Min.work temp.<br>8°C |
| **SETTINGS → RECOVERY →** | |
| **Regulation split** – defines how much of the 0..100% signal from the main temperature regulator will be executed by the heat recovery system<br>▪ Low limit: 0%<br>▪ High limit: 100%<br>▪ Default: 30%<br>**Frost protection** – setting for the lower limit of the exhaust air temperature after the recovery unit<br>▪ Low limit: -10°C<br>▪ High limit: 15°C<br>▪ Default: 5°C | Recovery →<br>Regulation split<br>30,00%<br>Frost protection<br>5°C<br>$K_p$ Frost prot.<br>5 |

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| | |
|---|---|
| **$K_p$ Frost prot. / $T_i$ Frost prot.** – settings for frost protection PI regulator<br>▪ $K_p$ – gain for the regulator<br>▪ $T_i$ – integral factor for the regulator<br>▪ Default: $K_p$=5 / $T_i$=10s | $T_i$ Frost prot.<br>10s |
| **SETTINGS → MIXING CHAMBER →** | |
| **Regulation split** – defines how much of the 0..100% signal from the main temperature regulator will be executed by the mixing chamber<br>▪ Low limit: 0%<br>▪ High limit: 100%<br>▪ Default: 30%<br>**Min fresh air** – setting for the minimum fresh air ratio at full frost protection<br>▪ Low limit: 0%<br>▪ High limit: 100%<br>▪ Default: 30%<br>**Fast heating / Fast heating** – setting to enable/disable the fast heating functionality. If enabled and the right conditions will be detected, the unit will heat up with fully forced recirculation to minimize the time and energy consumption.<br>▪ Not active (default setting)<br>▪ Active<br>**Fast heating / Temp. setpoint** – setpoint for the fast heating function<br>▪ Low limit: 10°C<br>▪ High limit: 30°C<br>▪ Default: 18°C<br>**Fast heating / Hysteresis** – setting for the actual temperature deviation from the setpoint value, that will activate the fast heating functionality<br>▪ Low limit: 2°C<br>▪ High limit: 10°C<br>▪ Default: 4°C | Mix chamber →<br>Regulation split<br>30,00%<br>Min fresh air<br>30,00%<br>Fast heating →<br>Fast heating<br>Not active<br>Temp.setpoint<br>18°C<br>Hysteresis<br>4°C |

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# ADVANCED MANUAL

## 6. SERVICE MENU →

Service menu contains the most fundamental settings, necessary for proper configuration and safe startup of the unit. Moreover, some service–oriented functions are available here for easy maintenance and troubleshooting for service staff.

### SERVICE MENU → SERVICE MODE →

**Service mode** – setting to enable/disable service mode

- Off – the service mode disabled, controller ready for normal operation
- On – service mode enabled, controller ready for configuration and locked – no control functions can be executed
- Default state for first power-up is On – the service mode is factory state, as the controller requires configuration before normal operation.

***Note!*** *The controller wouldn't start for normal operation if set to Service mode. After completing all the configuration switch the Service mode to Off!*

### SERVICE MENU → CHOOSE APPLIC. →



**Choose application** – sub-menu for entering the Application Code that defines the actual type of the unit that will be controlled by the control box.

- **Application type** – setting for the letters from the application code given in the datasheet of the air handling unit
  - **AD**
  - **AP**
  - **AR**
  - **AS**
  - **ND**
  - **NS**
- **Application code** – the number from the application code
  - **0..257**
- **Confirm code** – indication if entered code is included in the list of allowed applications
  - **Error** – check the settings for the type and code of the application
  - **OK** – settings approved

### SERVICE MENU → CONFIGURATION →

**S6 switch mode** – setting for the universal digital input for auxiliary start/stop switch S6 (Aux).

- **OR** – switch S6 is digital OR with start / stop command set in the HMI

  ***Note!*** *OR is default configuration.*

- **AND** – switch S6 is digital AND with start / stop command set in the HMI

**DI1 input mode** - configuration of the universal digital input DI1, three different modes can be selected

- **S1F (Fire)** – fire alarm signal, stops and locks the AHU if triggered, NC voltage free contact
- **xSxH (Filters)** – filter pressure drop warning, default setting for DI1, displays an alarm without affecting AHU operation, NO voltage free contact

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- **S6 (Aux)** – external start/stop signal, NO voltage free contact

***Note! DI1 input mode*** *setting are available only in N… applications where hardware input DI1 is a configurable resource. As the functions of hardware inputs are different for A… and N… applications, observe the control application diagrams and follow them strictly.*

**Main sensor / Main sensor** – selection of main temperature sensor for temperature regulation.

- **T.Sup** – supply air temperature sensor
- **HMI** – room temperature sensor inbuilt in the HMI OPTIMA

**Main sensor / Max. HMI resp. time** – timeout for communication. If exceeded, the controller will report the error of main temperature measurement.

- Low limit: 0s
- High limit: 100s
- Default: 15s

**DX protection mode** – setting for the digital input of refrigeration unit alarm

- NC – normally closed (default)
- NO – normally opened

**Supply FC / Communication** – setting to enable / disable communication with the frequency converter of supply fan set

- Disabled (default)
- Enabled

**Supply FC / Modbus address** – setting of the slave address for the supply fan frequency converter

**Supply FC / Min frequency** – lower frequency limit corresponding to 0% of fan stage setting

- Low limit: 10Hz
- High limit: 50Hz
- Default: 20Hz

**Supply FC / Max frequency** – upper frequency limit corresponding to 100% of fan stage setting

- Low limit: 10Hz
- High limit: 100Hz
- Default: 60Hz

**Supply FC / Acceleration** – setting for acceleration time of the fan set

- Low limit: 30s
- High limit: 120s
- Default: 60s

**Supply FC / Deceleration** – setting for deceleration time of the fan set

- Low limit: 20s
- High limit: 100s
- Default: 60s

**Exhaust FC / ...** – the same settings for frequency converter of the exhaust fan set

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**RRG FC / ...** – the same settings for frequency converter of the rotary energy regenerator

**Response timeout** – setting for max waiting for a slave to respond. If the time was exceeded, the error will be detected. It is recommended to not modify that parameter.

Factory setting: 0,3s

**Comm break time** – setting for idle time on the communication line between sending next packets. It is recommended to not modify that parameter.

Factory setting: 2,0s

**SERVICE MENU → INPUT STATES →**

**Digital inputs** – readout of the actual states of hardware digital inputs

- D1 – Opened / Closed
- D2 – Opened / Closed
- D3 – Opened / Closed
- D4 – Opened / Closed

**Sensor inputs** – readout of actual values read by temperature sensors Pt1000

- P1
- P2
- P3

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**SERVICE MENU → OUTPUT STATES →**

**Relay outputs** – readout of the actual states of hardware digital outputs

- REL1 – Off / On
- REL2 – Off / On
- REL3 – Off / On

**Analog outputs** – readout of actual values sena to hardware analog outputs

- A1 – 0..10V
- A2 – 0..10V

**SERVICE MENU → INPUT EMULATION →**

**Digital inputs** – overwriting the states of hardware digital inputs

- D1 – None / Set opened / Set closed
- D2 – None / Set opened / Set closed
- D3 – None / Set opened / Set closed
- D4 – None / Set opened / Set closed

**Sensor inputs** – overwriting the actual values read by temperature sensors Pt1000

- P1 emulate – Disabled / Enabled – select to activate the overwriting
- P1 temp. - enter the value
- P2 emulate – Disabled / Enabled – select to activate the overwriting
- P2 temp. - enter the value
- P3 emulate – Disabled / Enabled – select to activate the overwriting
- P3 temp. - enter the value

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**SERVICE MENU → OUTPUT FORCING →**

**Relay outputs** – overwriting the actual states of hardware digital outputs

- REL1 – None / Force Off / Force On
- REL2 – None / Force Off / Force On
- REL3 – None / Force Off / Force On

**Analog outputs** – overwriting the actual values sent to hardware analog outputs

- A1 forcing – Disabled / Enabled – select to activate the overwriting
- A1 voltage – 0..10V
- A2 forcing – Disabled / Enabled – select to activate the overwriting
- A2 voltage – 0..10V

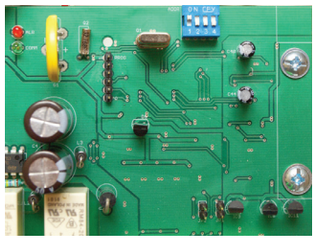
**SERVICE MENU → RESTORE DEFAULT SETTINGS →**

To restore default settings of the controller press OK. Then confirm once again.

***Note!*** *Restoring default values causes irreversible erase of all settings done before. Full re-configuration of the controller is required.*

In case of failure with the restore via HMI (e.g. HMI wouldn't communicate with the controller), follow another procedure:

- turn off the power supply
- set all the addressing dip-switches to ON (remember original setting, to apply that after the restore procedure)
- turn on the power supply (alarm LED should light up continuously)
- turn off the power again
- set the addressing dip switches to previous combination and turn on the power supply
- (done)



**SERVICE MENU → ALGORHITM LPS →**

Algorhitm LPS indicates the speed of application execution in “loops per second”.

**7. FREQUENCY CONVERTER CONFIGURATION**

As the control box uses Modbus communication to control the frequency converters, it is required to make proper configuration of those devices prior to startup of the unit.

***Note!*** *Improper configuration of frequency converters could cause dangerous malfunctions of the unit!*

Maximum of three frequency converters can be installed with OPTIMA control box:

- FC for single supply plug fan
- FC for single exhaust plug fan
- FC for rotary heat regenerator RRG (see: Drive Unit for Rotary Exchanger manual)

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***Note!*** *Mind the proper addressing of the frequency converters, which is crucial for correct operation of the unit.*

***Note!*** *The LS frequency converters can be restored to factory configuration by setting the parameter H93 to 1 and consecutive switching Off and On again.*

| Name of the parameter | Code | Value | Remarks |
|---|---|---|---|
| Source of control | DRV | 3 | Modbus |
| Source of frequency reference | Frq | iC5:8 / iG5:7 | Modbus |
| Stopping method | F4 | 0 | ramp down |
| Max output frequency | F21 | 100,0 | Hz |
| Motor rated frequency | F22 | 50,0 | Hz |
| U/f curve characteristics | F30 | 1 | square charact. |
| Motor overload protection | F50 | 1 | enabled |
| Motor poles number | H31 | * | see nameplate |
| Motor rated slip frequency | H32 | ** | to be calculated |
| Motor rated current | H33 | * | see nameplate |
| No load motor current | H34 | * | 1/3 rated current |
| Modbus address | I60 | * | 2 – supply fan<br>3 – exhaust fan |
| Reaction on communication loss | I62 | 2 | ramp stop |
| Communication timeout | I63 | 10,0 | s |

Formula to calculate the rated slip frequency:

H32 = (1 - H31 * rated_rpm / 6000) * 50 Hz

## 8. ALARM HANDLING

Alarm states are indicated by blinking display and flashing LED lamp on the HMI OPTIMA device, by switching the relay output and by the LED lamp on the main controller PCB inside the control box.

In the HMI, alarms can be accessed via the Alarm Menu. The menu is available on long-pressing of the button [C] (approx. 3s).

***Note!*** *In the default factory mode, the HMI switches to the Alarm Menu automatically when the alarm appears. The actual behavior depends on the HMI settings.*

Each alarm is displayed in the following manner:

| A9_HW_ThAir |
|---|
| 09:05.16 22-10 |

where A9_HW_ThAir stands for the name of the alarm and the bottom line indicates the time and date when the alarm was detected. Except of the displayed text, the alarm LED starts to blink when new alarm is detected.

All the alarms can be divided in two groups:

- Self-release alarms – the unit is restarted automatically when the alarm signal disappears, marked with A1, A2... codes
- Blocking alarms – manual acknowledge is required to restart the unit, marked with A50, A51... codes

To acknowledge the alarm hold the [OK] button. Earlier, the cause of the alarm should be eliminated. Otherwise, the [*] symbol will appear next to the name of the alarm, to indicate that the cause of the alarm is still valid, regardless to the alarm confirmation. In such case, the LED stops blinking and switches to solid red light.

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***Note!** Each blocking alarm needs to be acknowledged separately. Holding the [OK] button affects only the alarm, that is currently displayed on the HMI.*

**LIST OF SELF RELEASE ALARMS**

| Alarm name | Description | Input | Controller reaction |
|---|---|---|---|
| A1_Filter | dirty filter indication | D3 | no reaction |
| A2_FCsCom | supply FC communication error | Modbus | immediate unit stop |
| A3_FCeCom | exhaust FC comm. error | Modbus | immediate unit stop |
| A4_Tmain | main temperature sensor lost | - | unit stop |
| A5_Tsup | supply temperature sensor lost | P1 | unit stop |
| A6_Tout | external temperature sensor lost | P2 | unit stop |
| A7_Trec | after recovery temp. sensor lost | P3 | unit stop |
| A8_HE_Th | overheating alarm of el. heater | D2 | unit stop |
| A9_HW_ThAir | frost alarm of water heater | D2 | unit stop, pump On, valve 100% |
| A10_DX | alarm of the DX cooler | D2 | cooler stop |
| A11_FCrCom | RRG FC communication error | Modbus | unit stop |
| A12_InEmul | emulation of input | - | unit stop |
| A13_OutForce | force of output | - | unit stop |
| A14_Troom | HMI room sensor lost | Modbus | unit stop |
| A15_preHW_ThAir | frost alarm of water pre-heater | D3 | unit stop |

**LIST OF BLOCKING ALARMS**

| Alarm name | Description | Input | Controller reaction |
|---|---|---|---|
| A50_MotSup | supply motor / FC protection alarm | Modbus | immediate unit stop |
| A51_MotExh | exhaust motor / FC protection alarm | Modbus | immediate unit stop |
| A52_3xTmain | main temperature sensor error repeated 3x within one hour | - | unit stop |
| A53_3xTsup | supply temperature sensor error repeated 3x within one hour | P1 | unit stop |
| A54_3xTout | external temperature sensor error repeated 3x within one hour | P2 | unit stop |
| A55_3xTrec | after recovery temperature sensor error repeated 3x within one hour | P3 | unit stop |
| A56_3xHE_Th | overheating alarm of el. heater repeated 3x within one hour | D2 | unit stop |
| A57_3xHW_ThAir | frost alarm of water heater repeated 3x within one hour | D2 | unit stop, pump On, valve 100% |
| A58_3xDX | alarm of the DX cooler repeated 3x within one hour | D2 | cooler stop |
| A59_MotRRG | RRG motor / FC protection alarm | Modbus | unit stop |
| A60_Fire | fire protection activated via binary input | D1 | immediate unit stop |
| A61_3xTroom | room temperature sensor error repeated 3x within one hour | - | unit stop |

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| 9. TECHNICAL DATA | | | |
|---|---|---|---|
| **Parameter** | **VS10-75 CG OPTIMA** | **VS 40-150 CG OPTIMA SUP** | **VS 40-150 CG OPTIMA SUP-EXH** |
| Weight | 6,5 | 7,0 | 7,5 |
| Dimensions W x H x D | 240x300x130 | 240x400x130 | 240x400x130 |
| Electrical supply system | TN | | |
| Rated power supply voltage | ~230V | 3~400V | 3~400V |
| Rated current In | 31A | 28A | 49A |
| Rated insulation voltage Ui | 400V | | |
| Rated impulse withstand voltage Uimp | 2.5kV | | |
| Rated short-time withstand current Icw for respective circuits – effective value of alternating current component withstood during 1 second, i.e. short-circuit current expected at rated connecting voltage | 6kA | | |
| Rated peak withstand current (ipk) at cosφ= 0.5 | 10.2kA | | |
| Rated short-circuit current | 6kA | | |
| Coincidence factor | 0.9 | | |
| Rated frequency | 50Hz ±1Hz | | |
| Protection class | IP20 | | |
| Acceptable operating temperature | 0..40°C | | |
| Supply voltage of control circuits | 24VAC | | |
| EMC environment | 1 | | |
| **PARAMETERS OF PROTECTION UNITS** | | | |
| F1 | 6,3A / 250V 5x20 glass fuse | | |
| F2 | 6,3A / 250V 5x20 glass fuse | | |
| F3 | 16,0A / 250V 5x20 ceramic fuse | | |
| F4 | 16,0A / 250V 5x20 ceramic fuse | | |
| **INPUT / OUTPUT HARDWARE CHARACTERISTICS** | | | |
| **Digital inputs D1..D4** | | | |
| Nominal input voltage | 24VAC / 24 DC | | |
| High state detected within range | 15..27VAC / 16..38VDC | | |
| **Temperature measurement inputs P1..P3** | | | |
| Sensor type | Pt1000 | | |
| Min. load resistance | 0Ω | | |
| Refresh time | 60ms | | |
| Range | -76..105°C | | |
| Accuracy | ±0.5°C | | |
| Resolution | 8bits / °C | | |
| **Analog outputs A1, A2** | | | |
| Rated voltage | 0..10V | | |
| Max. load | 20mA | | |
| Min. load resistance | 500Ω | | |
| Resolution | 7bits / V | | |

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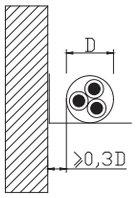
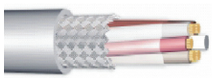
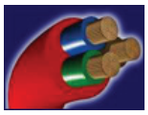
| | |
|---|---|
| **Relay ouputs** | |
| Max. switching voltage | 250VAC |
| Min. switching voltage | 5VDC |
| Rated current in AC1 / DC1 class | 8A |
| Min. current | 10mA |
| Rated long term load | 8A |

## 10. CABLING




Connect power leads of the control box and frequency converter of the fan drive according to the Electric diagram. The wire cross-sections have been selected for long term current capacity for cables arranged in the air (supported on brackets, cable racks, in perforated trays) with spacing from the wall of min. 0.3 cable diameter, insulated with PVC, for 3-conductors loaded. Due to the protection selectivity, length, cable placement method and short-circuit currents, revise the feeders' cross-sections in the table below.

| Wire type | Picture | Description | Parameters |
|---|---|---|---|
| **[1]** |  | Control wires with copper cores with a shield. PVC isolation. | Nominal voltage: 300/500 V<br>Ambient temperature: -30 to 80°C |
| **[2]** |  | Copper cores. PVC isolation. | Nominal voltage: 450/750V<br>Ambient temperature: from –40 to 70°C |
| **[3]** | | Copper cores. PVC isolation. | Nominal voltage: 150 V<br>Ambient temperature; -20… 60°C |

| Name of element / connection point | Symbol | Wire type | Section [mm²] |
|---|---|---|---|
| Power supply for the control gear | CG | [2] | Table A |
| controller | N1 | - | - |
| fire alarm switch | S1F | [2] | 2x0,75 |
| multi-function switch | S6 | [2] | 2x0,75 |
| supply air temperature sensor | B1 | [1] | 2x0,75 |
| external air temperature sensor | B3 | [1] | 2x0,75 |
| after recovery air temperature sensor | B4 | [1] | 2x0,75 |
| HE alarm switch VTS-E-0005 | ter.23:24 VTS-E-0005 | [2] | 2x0,75 |
| HW anti-frost air side thermostat | S2F | [2] | 2x0,75 |
| HW analog controlled valve | Y1 | [1] | 3x0,75 |
| HE power rate control input VTS-E-0005 | ter. 15:21 VTS-E-0005 | [1] | 3x0,75 |
| HW circulating pump contactor | M1 | [1] | 3x1,5 |
| HW back-water sensor | B7 | [4] | 3x0,75 |
| glycol pre-heater anti-frost thermostat | S6F | [3] | 2x0,75 |
| glycol pre-heater analog valve | Y6 | [4] | 3x0,75 |
| glycol pre-heater circulating pump | M3 | [3] | 3x1,0 |
| cooling device alarm switch | S5F | [2] | 2x0,75 |

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| Name of element / connection point | Symbol | Wire type | Section [mm²] |
|---|---|---|---|
| cooling device start input | E1 | [2] | 2x0,75 |
| refrigerating unit start input – I stage | E2.1 | [2] | 2x0,75 |
| cooling device analog control signal (valve) | Y2 | [1] | 3x0,75 |
| RRG frequency converter | U1 | [1] [2] | 3x1,5 / 4x1,5 |
| RRG alarm switch | via Modbus | [3] | UTP 2x2 |
| RRG start input | | | |
| RRG speed reference input | | | |
| recirculation damper actuator | Y3 | [1] | 3x0,75 |
| cross-flow bypass actuator | Y4 | [1] | 3x0,75 |
| CWHW analog controlled valve | Y5 | [1] | 3x0,75 |
| AHU alarm | E4 | [2] | 2x0,75 |
| HMI OPTIMA | N3 | [3] | UTP 2x2 |
| **supply elements** | | | |
| pressure control - primary filter, supply | 1S1H | [2] | 2x0,75 |
| pressure control - primary filter, supply | 1S2H | [2] | 2x0,75 |
| pressure control - compression monitoring for HE-Module | 1S3H | [2] | 2x0,75 |
| supply frequency converter | 1U1 | [1] [2] [3] | Table A<br>UTP 2x2 |
| intake damper actuator | 1Y1 | [2] | 3x0,75 |
| **exhaust elements** | | | |
| pressure control - primary filter, exhaust | 2S1H | [2] | 3x0,75 |
| exhaust frequency converter | 2U1 | [1] [2] [3] | Table A<br>UTP 2x2 |
| outlet damper actuator | 2Y1 | [2] | 3x0,75 |

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**Table A**

| Motor rated power | Motor rated current | Frequency converter fuse | Cable powering FC | Cable powering motor | Cable powering the control box | | Rated current of the control box | |
|---|---|---|---|---|---|---|---|---|
| [kW] | [A] | | [mm²] | [mm²] | [mm²] | | [A] | |
| 3~230V / 50Hz | | ~230V / 50Hz | | | Supply | Sup-Exh | Supply | Sup-Exh |
| 0,55 | 2,5 | gG10 | 3x1,5 | 4x1 | 3x1,5 | 3 x Table C | 14 | Table B |
| 0,75 | 3,0 | gG10 | 3x1,5 | 4x1,5 | 3x2,5 | | 14 | |
| 1,1 | 4,5 | gG10 | 3x1,5 | 4x1,5 | 3x2,5 | | 17 | |
| 1,5 | 6,0 | gG20 | 3x2,5 | 4x1,5 | 3x4 | | 17 | |
| 2,2 | 8,0 | gG20 | 3x2,5 | 4x1,5 | 3x4 | | 20 | |
| 3~400V / 50Hz | | 3~400V / 50Hz | | | | | | |
| 3,0 | 6,0 | gG16 | 4x2,5 | 4x2,5 | 5x4 | 5 x Table C | 8 / 7,5 / 13 | Table B |
| 4,0 | 8,0 | gG16 | 4x2,5 | 4x2,5 | 5x4 | | 10 / 9,5 / 15 | |
| 5,5 | 11,0 | gG20 | 4x2,5 | 4x2,5 | 5x4 | | 13 / 12,5 / 18 | |
| 7,5 | 15,0 | gG20 | 4x2,5 | 4x2,5 | 5x6 | | 18 / 16,5 / 22 | |
| 11,0 | 21,0 | gG25 | 4x4 | 4x4 | 5x6 | | 23 / 22,5 / 28 | |

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**Table B**

| P | 0,55kW | | | 0,75kW | | | 1,1kW | | | 1,5kW | | | 2,2kW | | | 3kW | | | 4kW | | | 5,5kW | | | 7,5 | | | 11 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| kW | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| 0,55 | 19 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0,75 | 19 | | | 19 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1,1 | | | | 22 | | | 25 | | | | | | | | | | | | | | | | | | | | | | | |
| 1,5 | | | | 22 | | | 25 | | | 25 | | | | | | | | | | | | | | | | | | | | |
| 2,2 | | | | 25 | | | 28 | | | 28 | | | 31 | | | | | | | | | | | | | | | | | |
| 3 | | | | 12,5 | 10 | 13 | 14 | 10 | 13 | 15,5 | 10 | 13 | 17,5 | 10 | 13 | 14 | 13,5 | 19 | | | | | | | | | | | | |
| 4 | | | | 14,5 | 12 | 15 | 16 | 12 | 15 | 18,5 | 12 | 15 | 19,5 | 12 | 15 | 16 | 15,5 | 21 | 18 | 17,5 | 23 | | | | | | | | | |
| 5,5 | | | | 17,5 | 15 | 18 | 18 | 15 | 18 | 20,2 | 15 | 18 | 22,5 | 15 | 18 | 19 | 18,5 | 24 | 21 | 20,5 | 26 | 24 | 23,5 | 29 | | | | | | |
| 7,5 | | | | 21,5 | 19 | 22 | 23 | 19 | 22 | 24,5 | 19 | 22 | 26,5 | 19 | 22 | 23 | 22,5 | 28 | 25 | 24,5 | 30 | 28 | 27,5 | 33 | 32 | 31,5 | 37 | | | |
| 11 | | | | 27,5 | 25 | 28 | 29 | 25 | 28 | 30,5 | 25 | 28 | 32,5 | 25 | 28 | 29 | 28,5 | 34 | 31 | 30,5 | 36 | 34 | 33,5 | 39 | 38 | 37,5 | 43 | 44 | 43,5 | 49 |

**Table C**

| P [kW] | 0,55 | 0,75 | 1,1 | 1,5 | 2,2 | 3,0 | 4,0 | 5,5 | 7,5 | 11,0 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,55 | 4 | | | | | | | | | |
| 0,75 | 4 | 4 | | | | | | | | |
| 1,1 | | 4 | 6 | | | | | | | |
| 1,5 | | 6 | 6 | 6 | | | | | | |
| 2,2 | | 6 | 10 | 10 | 10 | | | | | |
| 3,0 | | 6 | 6 | 6 | 6 | 6 | | | | |
| 4,0 | | 6 | 6 | 6 | 6 | 6 | 6 | | | |
| 5,5 | | 6 | 6 | 6 | 10 | 10 | 10 | 10 | | |
| 7,5 | | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| 11,0 | | 10 | 10 | 10 | 10 | 10 | 10 | 16 | 16 | 16 |

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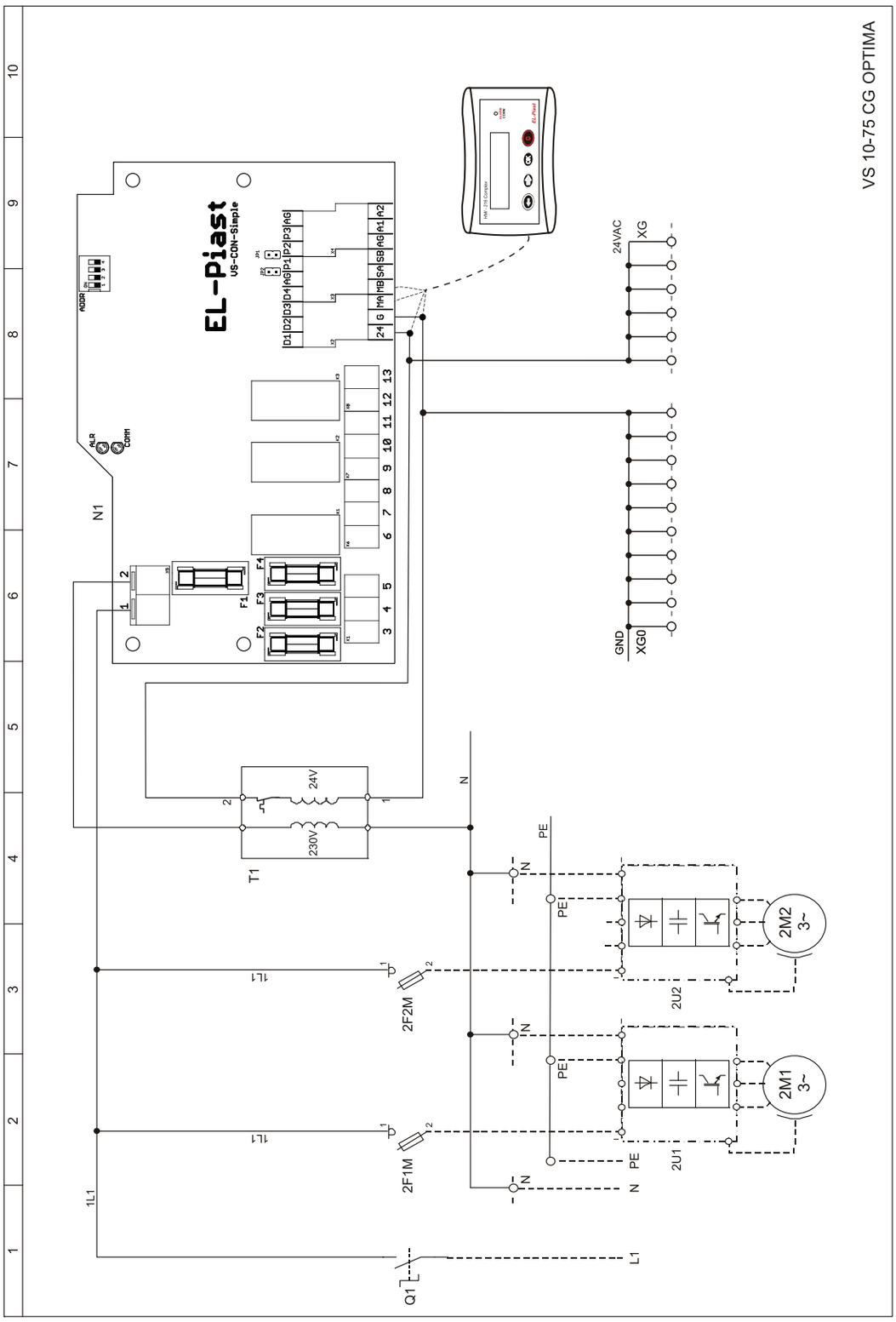
## 11. ELECTRIC DIAGRAMS

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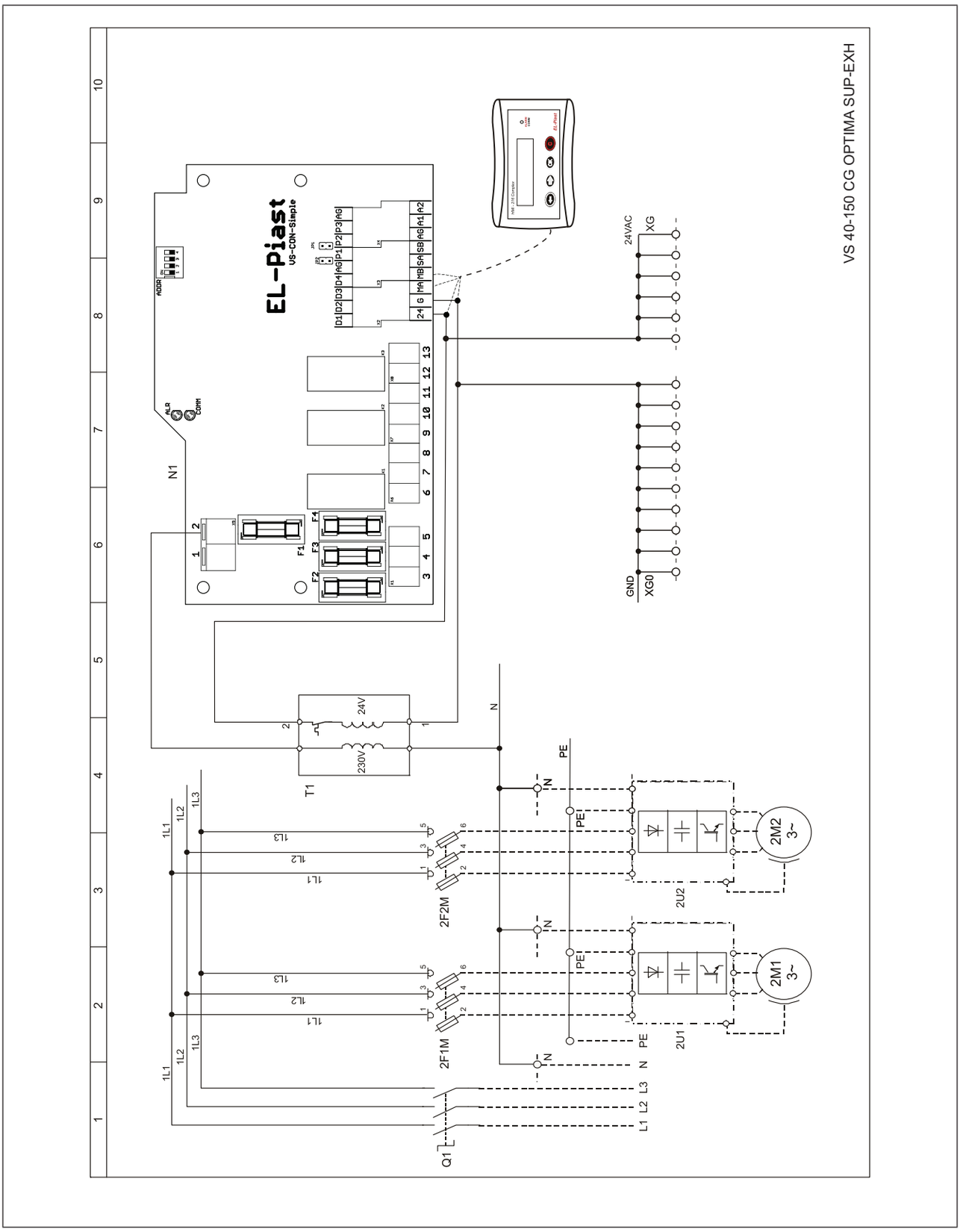


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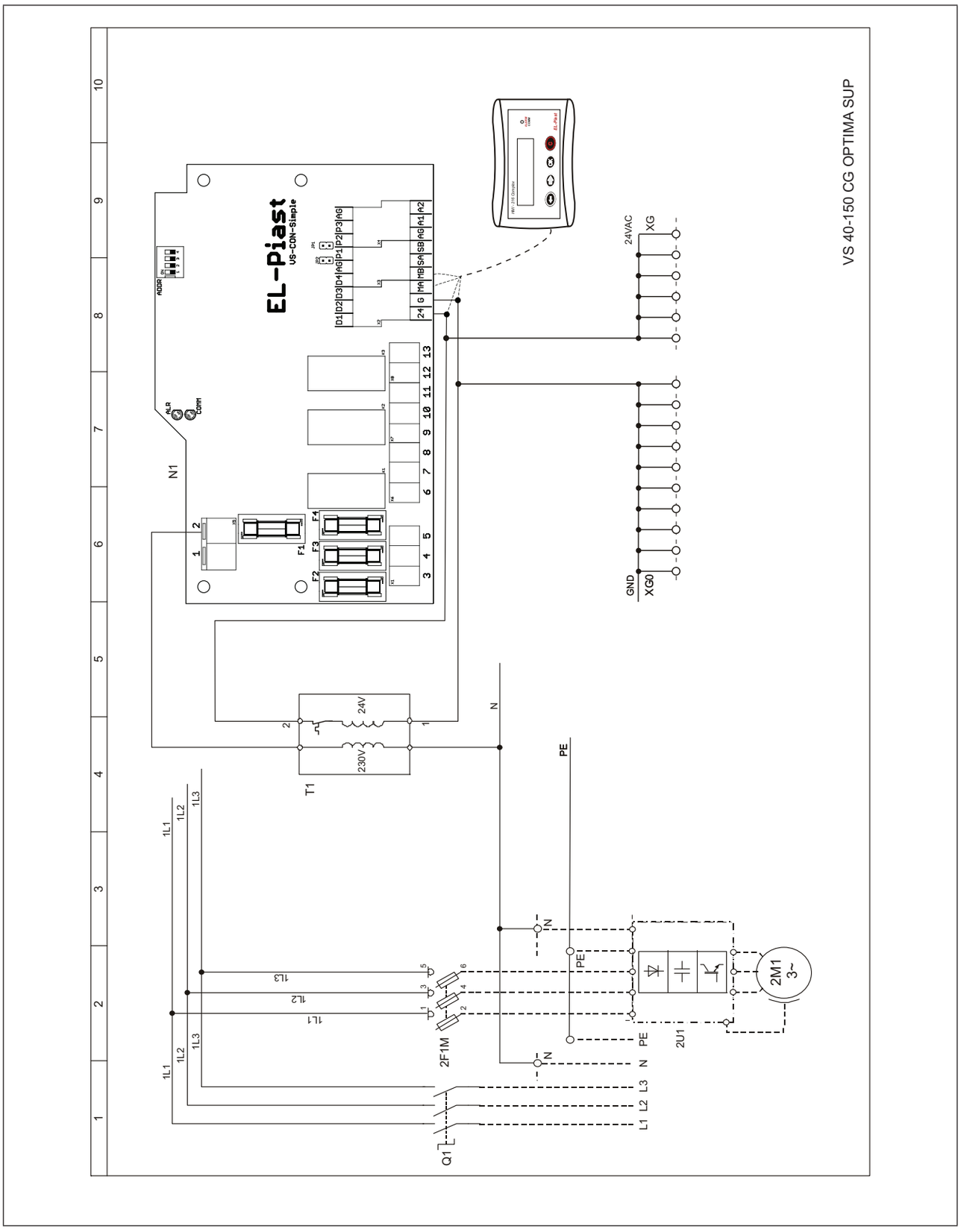


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